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TERRITORIAL ARMY AIRCREW – "THE SENIOR PILOTS" ARE THEY AT GREATER RISK?

Colonel Malcolm G. Braithwaite OBE L/RAMC*
Lieutenant Colonel Paul A. Cain RAMC†

*Headquarters Director Army Aviation
Middle Wallop, Stockbridge, Hampshire, SO20 8DY,
United Kingdom

† Headquarters Joint Helicopter Command
Erskine Barracks, Wilton, Salisbury, SP2 0AG
United Kingdom

SUMMARY

This paper presents evidence of the operational effects of ageing on British Army aircrew in two areas: a restriction on flying (and other military duties) and accidents due to human factors. The data suggest that the age of Army pilots should not be reduced for operational reasons. There is an underlying trend that, given that pilots with serious medical problems will tend to self-select themselves out of the service reasonably early, the more experienced aviator is both safer in flight and a lesser burden to himself, and the medical services.

INTRODUCTION

Over recent years, there has been much discussion about risk analysis associated with aging. This is explicitly summarised by Tunstall-Pedoe[1] in which it was determined that the accepted rate of cardiovascular mortality at age 60 roughly equates to 1% per year or a 1×10^{-6} risk of sudden incapacitation in any hour. It is also accepted that the risk increases with age beyond age 60. However, the age-specific cardiovascular mortality among carefully screened aviators is not known, and it may be reasonably surmised that within this population the risk is probably lower. Furthermore, this "quantifiable risk of sudden death" which increases with age, is also dependant on many other risk factors (other than age) such as the individual's health status, smoking, blood pressure, gender, blood lipids, family history etc. The result is that the "unacceptable risk level" is probably reached in different individuals at different ages. The risk of incapacitation is less clearly understood for many other clinical conditions[2].

Stimulated by the title of this symposium and with an ever increasing awareness of the issues of aging in the workplace, we examined the effects of aging in the population for which we provide a comprehensive occupational health service - the British Army Air Corps.

The British Army Air Corps (AAC) is a small but potent aviation force of 290 helicopters. In April, 1999 there were 712 regular and Territorial Army (TA) aircrew. Fifty-two (7.4%) of these were aged over 50 and only 3 (0.43%) were over 55 years of age. The maximum age for commencement of pilot training is 28 for officers and 30 for non-commissioned officers. Entry medical standards are stringent and, as the majority is aged 23 –30 when they start flying, a "healthy worker" effect will be apparent. It is British Army policy that officers and other ranks will not serve beyond the age of 55. There are, as ever, exceptions, and aircrew above this age may be extended a year at a time on a case by case basis.

Most of the "older" generation pilots are employed either in staff and administrative duties, or as flying instructors - the latter particularly because of their extensive experience. They rarely present a medical challenge because of their age. Indeed, the highest rate of attendance at military medical centres is in the younger age groups (sickness admission rates for the British Army during 1997 were 180.8 per thousand for the under 20 age group, and 44.9 per thousand for the 50-54 age group).[3] However, those that are of potentially greater importance in an aeromedical context are the TA pilots. In the main, these are pilots who have retired from regular service although many are still in civilian commercial flying practice. They are employed either as aircrew in the TA AAC regiment, or as "pool" pilots who reinforce regular AAC units. It is perhaps the "solo-operations" nature of the task that they perform that requires us to regard them as a special risk occupational group. There has only been one recorded instance in which our increased concern

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has been realised (a myocardial infarction occurring in-flight), but nevertheless, by virtue of the increasing incidence of disease within this age group, they are worthy of a special interest.

Older pilots, by virtue of their experience, are thought to be of high worth to an organisation but the value of that experience is difficult to quantify. One area that is relatively easy to examine is accident rates particularly those involving aircrew error. Intuitively, accident rates should be lower with increasing experience and therefore also with age. Data from the US Army[4] suggest that this is so. There may, however, be negative factors associated with ageing in the aviation environment, such as slower cognition that counterbalances increased experience[5]. Li and Baker[6] found the rate of fatal accidents to be higher in pilots aged 50 years or older. In crashes of homebuilt aircraft those aged over 60 years accounted for 36% of those involved compared to 15% in general aviation[7]. However, Li et al.,[8] found there to be no significant age-differences in pilot performance factors involved in aviation crashes. Within the AAC, flying experience has been associated with aircraft crashes and it is believed that 500 hours flying represents a point at which the risk of crashing is high. However, this has neither been standardised for pilot's total flying time nor has the effect of age been examined. Therefore, although there may be more evidence to suggest that increased accident rates are associated with increasing age in civilian flying, the reverse may be true in military aviation.

In this study, we have chosen to consider the operational issues solely with regard to the capacity of the Army helicopter pilot to undertake and successfully complete his or her mission.

METHODS

The ages of aircrew were derived from personal records of the Manning Division at a single point in April 1999. As it has not been readily possible to obtain age distributions from previous years, the denominator to determine age-specific incidence rates in the analysis is therefore the present age-distribution. However, it does enable a reasonable estimate of the magnitude.

Two discrete sets of data were scrutinised to determine the incidence of significant morbidity and accident experience.

Morbidity data

Army aircrew must maintain a minimum medical standard to remain eligible for flying duties. Following an annual medical examination or at other times if it is warranted by their medical condition, Army aircrew are awarded a flying medical category (FMC). This is in addition to their Army PULHHEEMS Employment Standard (PES). It must be remembered that these medical categories are not punitive but protective (to both the individual and the Army's resources). The allocation of these grades should allow both the effective management of the employability (and deployability) of aircrew, and the ability of the medical system to monitor their clinical condition. The categories are summarised in table 1.

Table 1: Summary of medical categories

Category		Interpretation
PES	P2FE	Fit for combat. PES will be FE (forward everywhere).
PES	P3 LE	Fit for light duties. Unfit for combat duty. PES will be LE (Lines of communication).
PES	P7 HO	Fit for limited duties. Only fit for specific military employment. PES will be HO (home only)
FMC	A1	Fit for full flying duties
FMC	A2	Fit for full flying duties but either wears corrective flying spectacles, or has a hearing category of H2.
FMC	A3	Fit for limited flying duties which must be relevant to Army Aviation, and explicitly specified and/or qualified (e.g. "with pilot qualified on type." A waiver is applied to these cases.
FMC	A4	Fit to fly as a passenger only in military aircraft.

Notes: PES = PULHHEEMS Employment Standard
FMC = Flying Medical Category

The medical records were examined of all aircrew who had been medically downgraded to the categories of A3 and A4 and/or a PES of P3LE or P7HO between January 1989 and June 1999. The date of award of these categories was chosen as a marker to indicate the time at which a medical condition operationally affected the operational employment of aircrew.

These categories are employment markers that signify morbidity that has an effect on operational performance. Aircrew may have a PES which restricts them from terrestrial duties whilst they are able to fly in an unrestricted capacity within a defined theatre of operations (e.g. anterior knee pain syndrome). Whilst Army pilots are "soldiers first," it is the restriction imposed on flying duties that has the greater operational impact and thus gains the greatest attention from the AAC executive. Although the incidence of conditions resulting in both "unrestricted" and "restricted" (flying duties) are presented, we have concentrated on the operational impact of the latter. The null hypothesis for this part of the study was therefore that there is no difference in the rates of "restricted" disease between age groups.

Accident experience

A retrospective analysis of rotary wing accidents whose classified cause was "Human Factors Aircrew" (HF (A)) over a 35-year period was carried out in order to identify any association between age and accident rates. All accidents from the start of the AAC accident database in 1965 through 1999 were selected for inclusion and used to identify medical accident investigation files and the proceedings of the Boards of Inquiry. In turn, these were searched manually for crew age at the time of the accident and correlated were possible. In multi-crew aircraft, only the ages of the front seat crew were recorded.
The age distribution of pilots in the Army Air Corps in April 1999 was extrapolated back over the 35 years of the study to give the number of years flying in each age group. Thus, for example, thirty-three 27 year old pilots flying over the 35 year period amassed a total of $33 \times 35 = 1155$ years of flying. Accident rates with 95% confidence intervals using the SE (p) were then calculated for individuals (rather than formed crews) over 5-year age groups. A comparison with the accident experience of the U.S Army was also made.

The null hypothesis in this case was that there was no difference in the accident rate with changing age.

RESULTS

The age distributions for both regular and TA aircrew are illustrated at figure 1 and the summary data are shown in table 2. Age data are conventionally grouped in 5-yearly intervals with the fourth and ninth year forming the top of consecutive ranges. However, we have illustrated our data with the fifth and decade years forming the top of each range so that the normal Army retirement age (55) coincides with the top of the penultimate range.

Table 2: Summary of age distribution data

	number	Mean	SD	Range	95% CI
Regular Army	614	34.59	7.16	21-55	34.02-35.16
Territorial Army	89	44.36	6.54	31-57	42.98-45.74

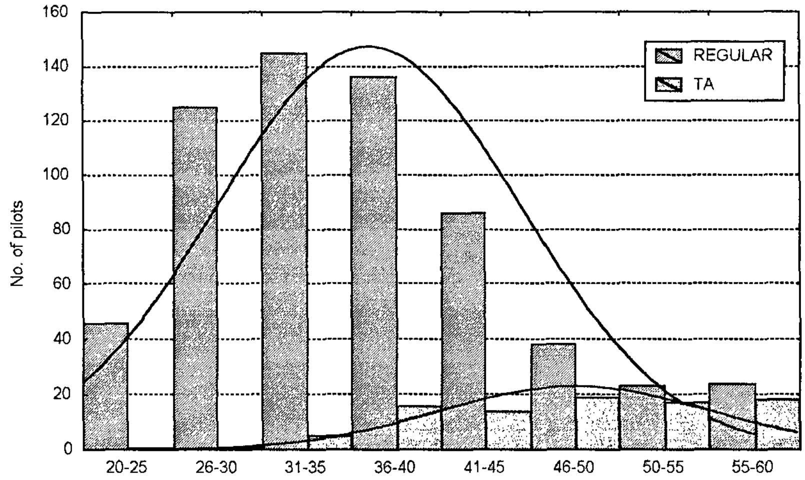

Figure 1: Age distribution of Army pilots (1999)

Morbidity

186 aircrew were downgraded between January 1989 and June 1999. For individuals in which there was coexisting morbidity both of which resulted in downgrading, the first condition to arise was recorded. Figure 2 summarises the clinical conditions.

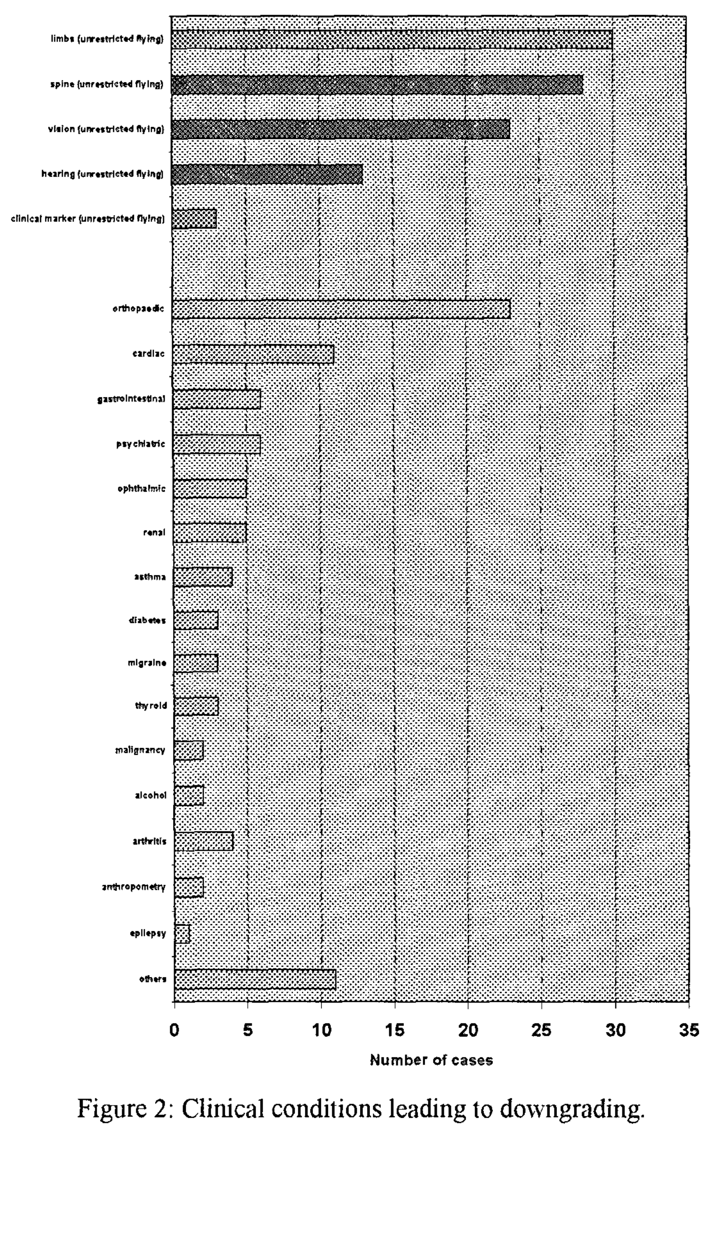

Figure 2: Clinical conditions leading to downgrading.

The incidence rates (by age group) for the most common conditions are shown in figure 3 (unrestricted flying duties) and figure 4 (restricted flying duties).

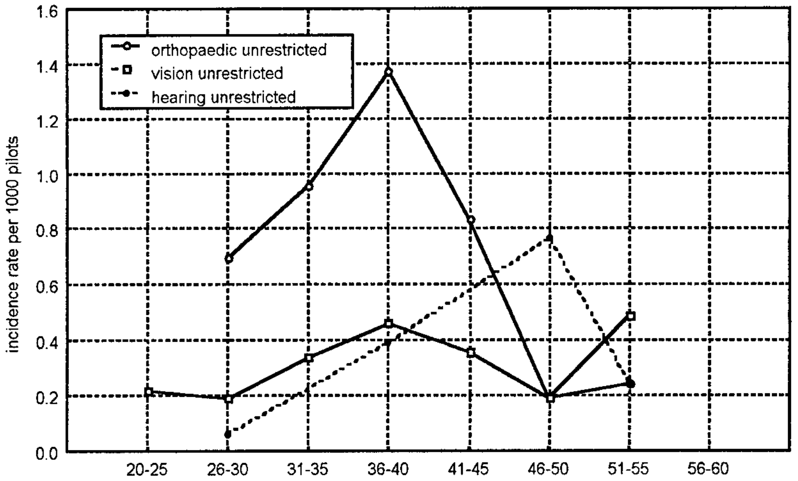

Figure 3: Incidence rate per 1000 aircrew of unrestricted" conditions

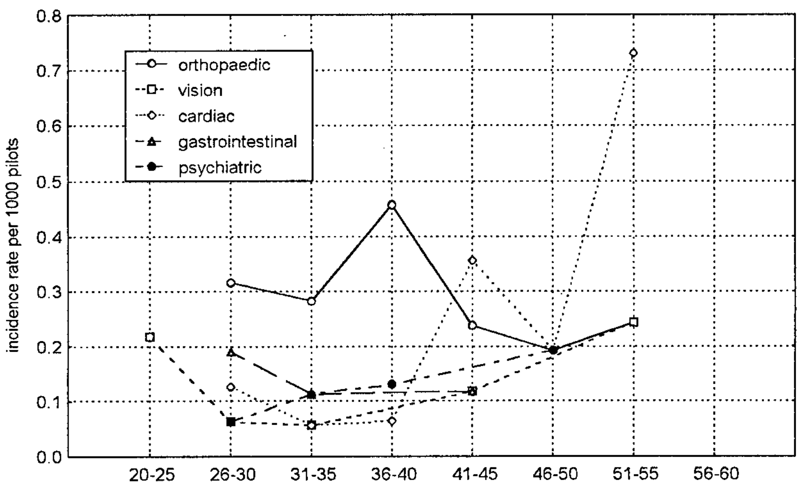

Figure 4: Incidence rate per 1000 aircrew of some "restricted" conditions

When the latter data are grouped together, an overall operational impact may be deduced. This is shown in the distribution of the age at which the initial restricted flying category was awarded (figure 5).

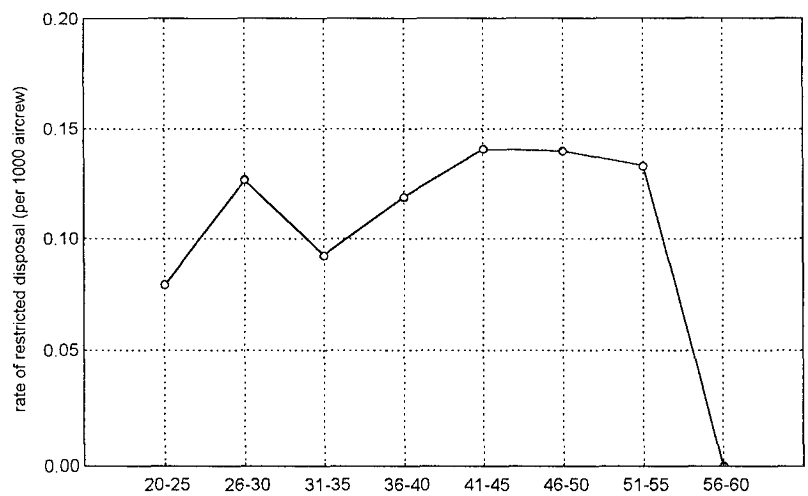

Figure 5: Rate of initial restricted flying category (by age group) (1989-1999)

The variation of both restricted and unrestricted flying categories by year within the age groups are shown in figures 6a & b.

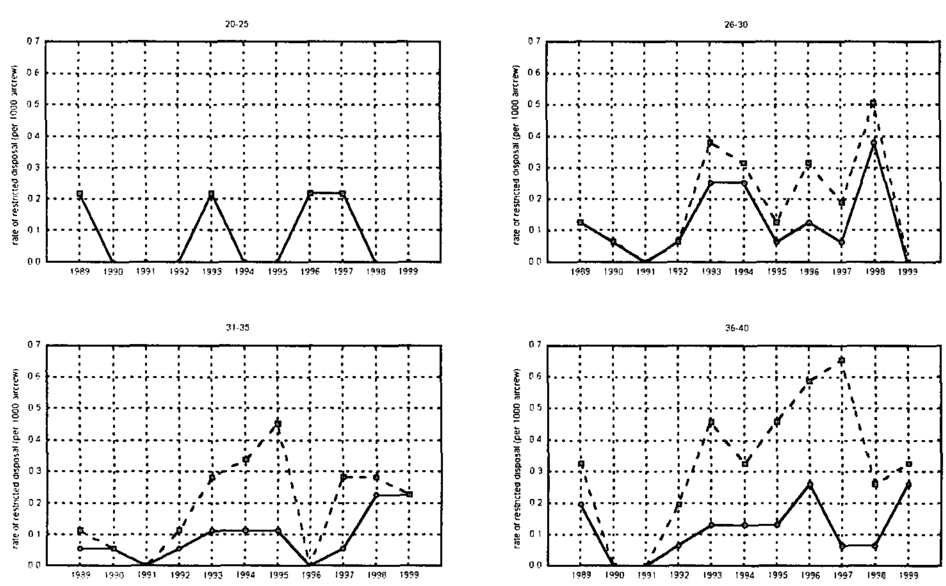

Figure 6a: Rate of initial restricted (solid line) and unrestricted (dashed line) flying category (by age group)

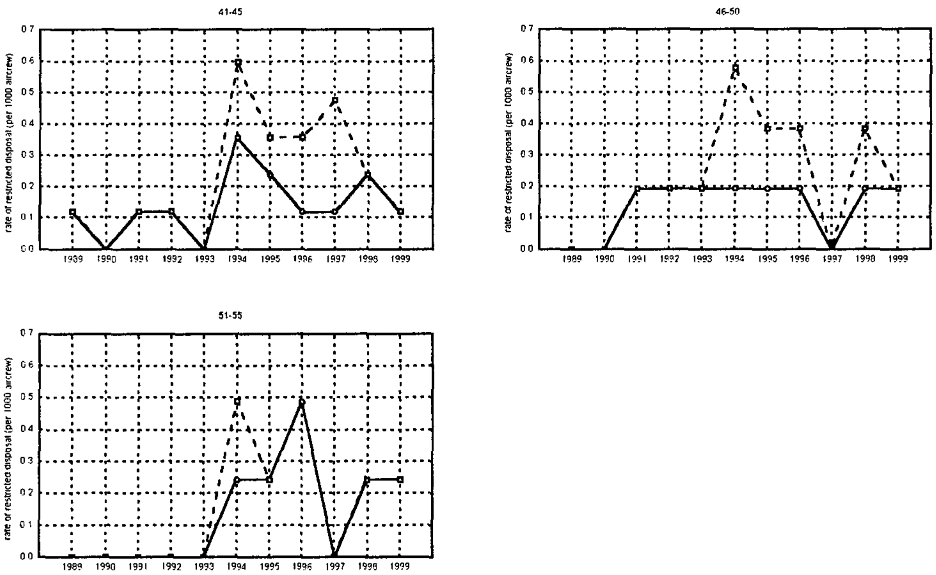

Figure 6b: Rate of initial restricted (solid line) and unrestricted (dashed line) flying category (by age group)

Accident data

Between 1965 and 1999, 135 aircrew were involved in 98 accidents. In 1999 there were 712 active pilots in the AAC. This therefore represents (712 x 35) 24920 years of flying. The overall accident rate was thus 5.42 accidents per 1000 years of flying. Only those HF(A) accidents for which no records could be found were excluded from the study. The outcome of the search is shown in Table 3.

Table 3: Profile for accidents included in the study

	Numbers
HF(A) group from database	111
Accidents removed due to incorrect coding	2
Un-coded accidents added	1
Total accidents 1965-99	110
Accidents for which records were found	98
Percentage of all accidents included in the study	89.1%

Table 4 and figure 7 show the number of accidents and the accident rates by age group. The accident rate is highest in the youngest group and decreases with increasing group age. The wide confidence intervals, particularly in the youngest age groups, mean that there is little significance in the change in accident rate between adjacent groups. There is, though, a significant reduction in the accident rate over the age range, with the youngest group being approximately twelve times more likely to be involved in a HF(A) accident than the oldest.

Table 4: Accident rate in Army Air Corps rotary-wing pilots by age group

Age (years)	Population (pilot/yrs flying)	Accidents	Rate (per 1000 flying yrs)	95% CI
20-24	840	11	13.09	± 7.69
25-29	5145	51	9.91	± 2.71
30-34	6405	47	7.34	± 2.09
35-39	5600	19	3.34	± 1.52
40-44	3150	5	1.59	± 1.39
45-49	1925	2	1.04	± 1.44
50-54	1750	0	0.00	
55-59	105	0	0.00	

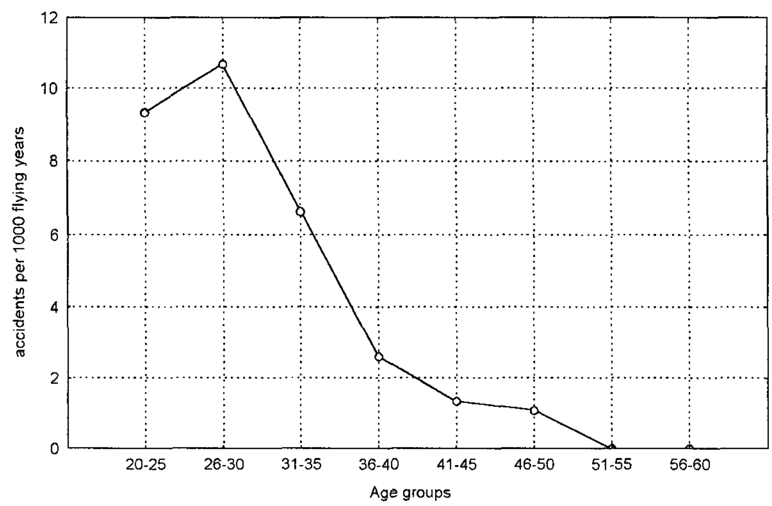

Figure 7: Human factors accident rate in Army Air Corps aircrew (by age group).

Figure 8 shows a comparison between the number of AAC accidents and those of the US Army. Even though the data illustrated are from different time periods, they show a remarkable similarity in trend.

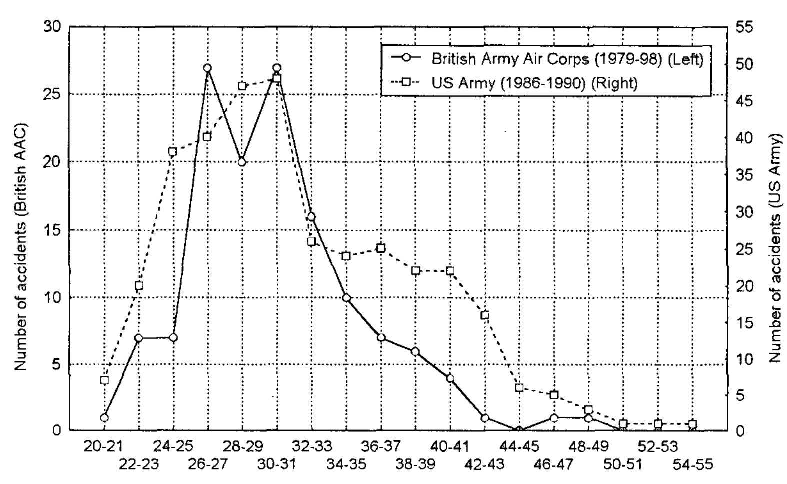

Figure 8: Comparison of British Army Air Corps and US Army Accident rates (by age group).

DISCUSSION

Although the data numbers are small, it can be seen that the incidence of clinical conditions resulting in a restricted flying category remains remarkably similar across the age groups (fig 5) until the 56-60 age group when it drops to zero. The latter may possibly be explained by the retirement policy in the Army - only those who are operationally fit are allowed to extend their service beyond the age of 55.

Orthopaedic reasons for a restricted grading dominate the majority of age groups. These conditions (in particular, postural spinal problems) are well known as a primary cause of military helicopter flying "disability."[9] The peak at age 36-40 probably reflects the stage at which the previously present disease process finally has an operational impact. Cardiac causes of restricted flying, most notably arrhythmia, not surprisingly have an increasing incidence with age. The visual causes of downgrading associated with the younger age group were invariably associated with injury, whilst the gradually increasing incidence with age is due to cases of glaucoma (and in some cases, the resultant aphakia). Gastrointestinal causes reflect the incidence of these types of disease in a young population - ulcerative colitis and Crohn's disease. The increasing trend with age of psychiatric causes is initially alarming except that the rate is very low (a total of 6 cases in 20 years) and may be explained by an increased incidence of "stress" affecting the older age groups.

Figures 6a and 6b illustrate that there are many cases of "terrestrial" downgrading that do not result in the diminishment of an aircrew medical category. This is especially true for the age groups ranging from 31 to 50. The majority of unrestricted cases are for orthopaedic reasons and the relative increase in downgrading over the last over 5 years probably represents a more effective management of the medical downgrading policy.

It is often presumed that as age increases, the incidence of illness also rises. While this may be true in the civilian population, our analysis reveals that the operational effect on military aircrew does not follow this pattern. In other words, increasing age does not have a significant operational effect on the flying task.

Only 19 of the TA aircrew were medically downgraded. Twelve of these had no restriction on their flying medical category, most being relatively minor conditions, e.g. waivers to allow them to wear corrective flying spectacles or because of noise induced hearing loss. The remainder were all graded "with a pilot current on type" for cardiovascular, neurological or ophthalmic reasons. Although a small number, this represents 7.9% of the TA aircrew population and, if not properly managed, could have a severe impact on TA AAC operations. Fortunately, all except two are within their last 2 years of service and have been retained for instructional and managerial duties rather than "active" flying duties. Despite their higher average age, there are less "with a pilot current on type" restrictions in the TA than in the regular Army. This may be explained as follows. First, most TA pilots are recruited from pilots leaving the service of the regular Army. To be eligible for TA service, they must have a current unrestricted flying medical category and therefore, the "healthy worker" effect is readily apparent. Second, the operational task that TA aircrew perform primarily involves solo pilot operations. Therefore, there is not the opportunity to continue to employ pilots in this restricted capacity.

It is a constraint of this study that the year by year age distribution of the AAC is unknown, and the use of the 1999 age distribution may have affected the results of this study. Over the last 15 years, there has been a tendency to reduce the age at which pilot training commences and this would tend to reduce the difference in both morbidity and accident rates. However, over this time frame there has also been a tendency to retain pilots for a longer period of service. This would act to inflate the differences. Overall, the combined effect is therefore thought to be minimal. Recording both crew members' ages in an accident involving a multi-crew aircraft is considered valid, as each plays a part in determining the fate of the aircraft. Even had this not been so, it is highly unlikely that an individual crew member could be singled out as the cause of an accident.

The strongest determinant of HF(A) accidents within this group would appear to be experience, with the youngest and least experienced aviators being the most likely to be involved in an accident. There were no accidents in the age range from 51-55 and neither were there any accidents in the range 56-60 years, although the denominator is particularly small in the latter case. Some 66.7% of Army Air Corps accidents have HF(A) as the primary cause.[10] This study provides strong evidence that at least up to the age of 54, and probably beyond that, the older aviator is the "safer" aviator. The data from the US Army are thus confirmed by this study, and it is likely that the military experience is different from that of the civilian flying population.

Within this review, it is pertinent to include the comments of the flying standardisation officers. They are firmly and unanimously of the following

opinions. In the current training and operational climate, the older aviator has a greatly increased number of flying hours compared to the relative novice. He has had more "check-rides," standardisation assessments, and has seen and experienced more. He is therefore trained and judged to be a better pilot. The standardisation team is however wary that in the future, particularly with the anticipated lower number of flying hours on the WAH-64 Apache attack helicopter, the aviator will get to be an older pilot with fewer hours.

THE IMPACT OF AGING ON FUTURE OPERATIONS

Compared to civilian flying, the AAC does not have the "luxury" of employing "multi-pilot crew. Even with a side by side cockpit, the consequence of incapacitation in military helicopter flying is much greater than civilian flying because of the low-flying nature of the task. In the WAH-64 Apache attack helicopter, the crew's roles are very different and they are tandem-seated. Therefore, one cannot regard the composition as a multi-crew, even though there are 2 members present. Nevertheless, the retention of the older aviator presents the opportunity for the greatest operational gain. Modern military helicopters are expensive; the WAH-64 Apache costs c.£30 million per airframe. This battle winning equipment will therefore be a scarce resource and it is possible that the older pilot is best placed to preserve the fighting power of a force simply by virtue of the fact that he or she is most likely to return the aircraft intact.

In conclusion, our study reveals that there is no evidence to suggest that the age of Army pilots should be reduced for operational reasons. On the contrary, there is an underlying trend that, given that pilots with serious medical problems will tend to self-select themselves out of the service reasonably early, the more experienced aviator is both safer in flight and a lesser burden to himself, and the medical services. They are also well attended by a flight surgeon and therefore, unless alternative evidence is presented, the aeromedical advice to the AAC will be to continue employing these aircrew in their current capacity, and thus to enjoy the operational effectiveness of our senior pilots well into the millennium!

Disclaimer

Any views expressed in this paper are those of the authors, and do not necessarily represent those of the Ministry of Defence.

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